Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Authorization and Use of Software Defined Radios	)	ET Docket No. 00-47
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COMMENTS OF INTEL CORPORATION

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I. SUMMARY

Intel Corporation is pleased to comment in support of the Commission's Notice of Proposed Rulemaking concerning the authorization and use of Software Defined Radios (SDR).[1] Intel believes that SDR promises many benefits for existing, and possibly entirely new, markets.

Broad deployment of SDR could promote competition and innovation by enabling easy switching between different frequencies, carriers, and networks, as well as lowering the costs of software development. Even in the near-term, SDR handsets targeted toward cellular communications could use software to switch from AMPS to ANSI-136 to GSM or EDGE[2] and play a vital role in driving the software innovations essential to unleashing the potential of next generation wireless networks.

However, achieving the full benefits of SDR in the software market will depend on whether third parties can easily create and deploy new applications and services for wireless devices. Specifically, Intel recommends that SDR rules (1) distinguish between radio control and user application software and not impose certification requirements on user application software and (2) permit a manufacturer to create an open SDR platform that would enable third parties to develop innovative programs that optimize the RF parameters of the radio and seek certification as a Class III permissive change on their own. Experience in both the wireless and wired industries demonstrates the workability and benefit of market solutions that maintain network integrity but foster the development of innovative products.

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[1] *In the Matter of Authorization and Use of Software Defined Radios,* ET Docket No. 00-47, Notice of Proposed Rulemaking (rel. December 8, 2000) *("NPRM").*

[2] Comments of SBC Wireless, Inc. in ET Docket No. 00-47 (filed June 14, 2000) at 11.

II. POTENTIAL BENEFITS OF SDR

A. SDR can produce near-term benefits in the cellular market.

Although many of the SDR features discussed in the NOI[3] will require wide-band operation and are not yet feasible, SDR features requiring operation over a limited range of frequencies may produce significant consumer benefits in the near-term. For example, SDR cellular handsets may be able to use software to change from AMPS to ANSI-136, to GSM or EDGE or other air interface standards.[4]

B. SDR can foster a horizontal industry structure that will promote competition and innovation.

The PC industry and the Internet provide two powerful examples of how a horizontal or "layered" industry structure can promote competition and innovation in applications and services. In particular, the creation of separations or abstraction layers between elements of a network can facilitate easy entry, rapid innovation and robust competition. SDR technology would allow development of devices that would enable applications to access multiple networks. This "De-lamination" was discussed by Professors Michael Katz and Dave Messerschmitt at the recent Telecommunications Policy Workshop at the University of California, Berkeley.[5] Professor Messerschmitt stated that SDR and mobile code technology could create in the wireless domain the same unbundling of application and infrastructure that is largely responsible for the dramatic growth of the Internet.[6]

By facilitating such an unbundling between radio control and user application software, and

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[3] Notice of Inquiry Regarding Software Defined Radios, ET Docket No. 00-47 (rel. March 21, 2000) *("NOI").*
[4] Comments of SBC Wireless, Inc. in ET Docket No. 00-47 (filed June 14, 2000) at 11.
[5] <http://www.haas.berkeley.edu/%7Eimio/crtp/workshop/indexa.html>.

by creating "a programmable platform", SDR will foster software innovation that could be vital to the future success of the cellular industry. A programmable platform would lower entry costs for the independent third party developers who played a key role in delivering innovative solutions elsewhere. Alfred D. Chandler and James W. Cortada in *A Nation Transformed by Information*[7] state that the development of software products and application represented a sea change in information technologies. They conclude that although there is a "striking continuity in the [information] infrastructural evolution…The most obvious, dramatic, and important difference was software." [8] Elsewhere, they state "that it [software] is a new element in the business and technological landscape of American information history"[9] and that "software represented a profound discontinuity with prior information-technology patterns of behavior."[10]

Some industry observers believe that such software innovation could be especially important in the cellular market. For example, Hal Varian has pointed out that the investments in cellular networks, in many respects, resemble the build out of railroad systems in the 1880's. However, he believes that the wireless operators can avoid the fate of the railroads in the 1890's, if they increase the overall market size by providing new uses for new users.[11]

Similarly, in commenting on the $125B that the European operators spent on 3G spectrum, the *Economist* recently stated that "TELECOMS companies in Europe are in the process of making what may prove to be the biggest gamble in business history."[12] Contending that "the operators

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[6] <http://socrates.berkeley.edu/%7Eecon100/workshop/messer2.pdf>.
[7] Alfred D. Chandler and James W. Cortada, eds., *A Nation Transformed by Information: How Information Has Shaped the United States From Colonial Time to the Present* (Oxford: Oxford University Press, 2000).
[8] Ibid., p. 281.
[9] Ibid., p. 297.
[10] Ibid., p. 296.
[11] Hal Varian, "Miles and Miles of Flexible Track," Forbes ASAP (2 October 2000) <http://www.forbes.com/asap/2000/1002/071.html>.
[12] "The Wireless Gamble," *The Economist,* 12 October 2000.

have only the haziest idea of how they can make a return on these colossal investments," [13] it concludes that "the success or failure of these new phones will depend on the usefulness and cleverness of the services and applications that can be reached from them—**and those will be developed by third-party firms." (emphasis added)**[14]

III. THE SDR RULES SHOULD FOSTER THE PRO COMPETITION AND INNOVATION ASPECTS OF SDR.

As the Commission recognized in the NPRM, the existing certification process could unnecessarily curtail the benefits of SDR in promoting competition and innovation. This "migration" from three-minute voice economics to Internet innovation economics crystallizes, as recently stated by Chairman Powell, the "need to consider the Schumpeterian effect on policy and regulation."[15] This insight applies with special force to SDR, because software innovation cannot flourish in an environment where developers' programs and subsequent revisions must get separate regulatory approvals. The current rules governing modifications to certified equipment were developed in an era of single fixed-function devices labeled "NO USER SERVICEABLE PARTS INSIDE." Modifications and enhancements were either performed by the original manufacturer or licensed, technically-proficient amateurs. In the PC market, in contrast, a consumer can purchase a computer and then select from thousands of software applications provided by third parties to run on it. The PC market has, without any government regulation, simultaneously achieved compatibility for a myriad of software and hardware products as well as ever-increasing

[13] "A Finnish Fable," *The Economist,* 12 October 2000.
[14] Ibid.
[15] Remarks of FCC Commissioner Powell before The Progress & Freedom Foundation "THE GREAT DIGITAL BROADBAND MIGRATION" Washington, D.C., December 8, 2000.

performance.

IV. THE PROPOSED SDR RULES

Intel recommends that SDR rules (1) distinguish between radio control and user application software and not impose certification requirements on user application software and (2) permit a manufacturer to create an open SDR platform that would enable third parties to develop innovative programs that optimize the RF parameters of the radio and seek certification as a Class III permissive change on their own.

A. The definition of software defined radios should be limited to radio control software.

The definition of SDR should not cover software programs that are user applications and have no affect on the operating parameters of the radio. This could be accomplished by expanding the exception for cellular telephones contained in the definition in the NPRM (changed language in italics and bold):[16]

> **§ 2.1 Terms and definition.**
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> * * * * *
>
> (c) * * *
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> *Software defined radio.* A hardware and software platform that includes a transmitter in which the operating parameters of the transmitter, including the frequency range, modulation type and maximum radiated or conducted output power can be altered by making a change in software without making any hardware changes.
>
> Note: This definition is not intended to encompass ***software programs that do not alter the operating parameters of the transmitter or*** cellular telephones that use software simply to control functions such as power or frequency within a range approved by the Commission pursuant to Part 22 of the rules.

B. Third parties should be able to seek permissive changes under certain circumstances.

A manufacturer who creates an open SDR platform--with the intention that third parties can develop innovative programs that optimize the RF parameters of the radio and seek certification as a Class III permissive change on their own--should be allowed to do so. Although those programs that do modify the radio portions must be submitted to a certification process, the NPRM properly asks whether parties other than the grantee should be allowed to file for permissive changes. Intel proposes that paragraph 26 be modified to permit third party vendors to file for Class III permissive changes.[17] We agree with the SDR Forum that the Commission need not regulate who changes the software.[18] Some manufacturers may establish closed environments where developers must be licensed to create applications such as in the video game market. However, this requirement should be determined by the market and not mandated by Commission regulations. Forcing third party developers to go through a new approval process or mandating a relationship with the original manufacturer could undermine the value of this new change. The benefit of the Class III permissive changes will come in the enabling of thousands of independent developers, not simply easing the restrictions on ONE original manufacturer.

C. Experience shows that the perceived risks of this approach are manageable and well worth taking.

Many commenters in the NOI brought up the possibility that rogue software might compromise network integrity. This is an important concern. However we believe that experience

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[16]NPRM Appendix A.
[17]NPRM ¶26.
[18] Comments of SDR Forum in ET Docket No. 00-47 (filed June 14, 2000) at 33.

with wired networks and wireless devices has demonstrated that market forces will develop solutions that appropriately balance security with innovation.

For example, virtually every element of the Internet is software configurable and potentially subject to malicious control. The features and activities of clients, servers, and routers are determined by software, most of which can be downloaded from remote locations. The administration of networks would not be possible without the ability to control elements remotely. Such architecture is vulnerable to outside attack. Denials of Service (DoS) attacks have inflicted real damage on various commercial and institutional web sites. Although foolproof methods against DoS attacks are not likely to be developed, the market has succeeded in developing balanced solutions to meet varying demands of security, access and cost. Such market success is recognized in the recent review of part 68 where the "common vested interest of terminal equipment manufacturers and providers of telecommunications"[19] was cited as justification for completely eliminating significant portions of Part 68. These market forces are particularly powerful in the cellular industry where equipment manufacturers must pass a meticulous network type approval process imposed by the service providers.

In addition, government agencies with even more stringent security requirements develop solutions that are quickly disseminated to the public. A case in point is the Computer Security Research Center[20] provided by the NIST.

But the strongest evidence that the market will develop adequate risk management solutions to protect wireless networks is the existence of a vibrant market for handheld programmable wireless devices equipped with wireless modems. These devices, such as Compaq's iPaq,

[19] *In the Matter of 2000 Biennial Regulatory Review of Part 68 of the Commission's Rules and Regulations,* Docket No. CC 99-216, Report and Order, (rel. December 21, 2000) at 3.

Handspring's Visor, and laptop computers, require that the modem's power and frequency be under software control in order to function in a cellular network. However, no significant DoS network attacks have been reported. These systems employ an architecture that precludes the use of malicious code on the user application part of the platform that could corrupt the radio portions of the platform. The communications software that controls the operating parameters of the radio is completely separated from the user applications.

Recognizing that such an architecture is fundamental to a vibrant market for wireless application development, Intel has recently announced the Intel® Personal Internet Client Architecture.[21] This initiative will establish an open interface between the communication and application portions of wireless devices. By eliminating the cost and delay of meeting the type approval and certification requirements that apply to the communications software, this architecture will accelerate the development of third party wireless applications.

D. The Commission appropriately refrains from proposing specific requirements for authentication.

The Commission's rules governing commercial use of the wireless spectrum should accommodate the full panoply of differences in technologies, interference environments, etc. For example, an SDR device that is developed to operate in the ISM band should have much different authentication requirements than a user programmable device operating in the CMRS spectrum. Manufacturers and network operators need the flexibility to deploy solutions that balance their

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[20] <http://csrc.nist.gov/>.

[21] <http://developer.intel.com/design/wireless/pca/>.

particular need for security, cost, and accessibility.

Moreover, the market can be expected to continue to develop solutions to maintain the integrity of wireless networks while providing open platforms for application development. Security is a key competitive factor in the marketplace. Developers of hardware and software architectures, handset manufacturers, and industry associations such as the SDR Forums and ETSI, vigorously compete to supply the optimum solution.

V. CONCLUSION

SDR holds the promise of promoting competition and innovation by enabling easy switching between different frequencies, carriers, and networks as well as lowering the costs of software development. However, achieving the full benefits of SDR in the software market will depend on whether third parties can easily create and deploy new applications and services for wireless devices. Specifically, Intel recommends that SDR rules (1) distinguish between radio control and user application software and not impose certification requirements on user application software and (2) permit a manufacturer to create an open SDR platform that would enable third parties to develop innovative programs that optimize the RF parameters of the radio and seek certification as a Class III permissive change on their own. Experience in both the wireless and wired industries demonstrates the workability and benefit of market solutions that maintain network integrity and foster the development of innovative products.